Small Business Innovation Research/Small Business Tech Transfer

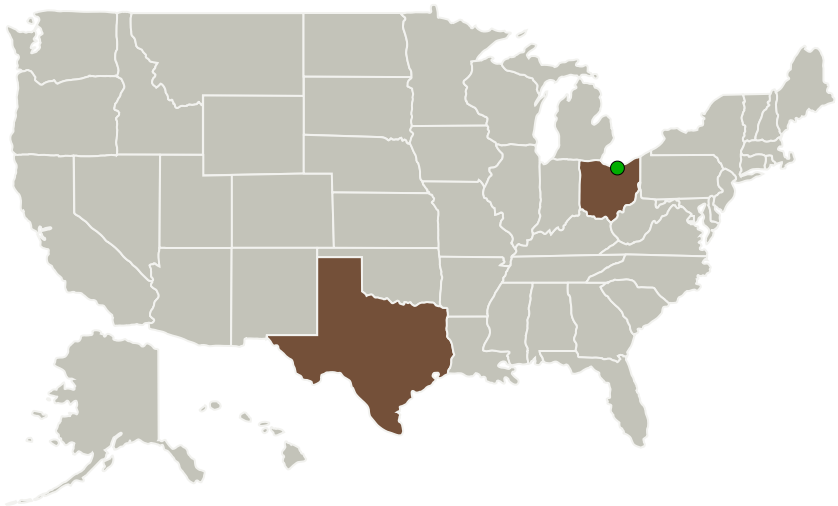
Low Cost Flexible Graphene-Based Digital Beam Forming Phased-Array Antennas, Phase I

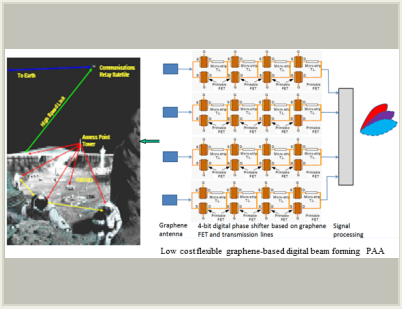
Completed Technology Project (2014 - 2014)

Project Introduction

Communication technologies support all NASA space missions, among which autonomous communication technologies are extremely beneficial to future missions. Communication technologies will expand mankind's understanding of planet earth and the universe. As the needs to gather more data, even more advanced antenna technologies will be essential to deliver orders of magnitude more data. Low cost high data-rate flexible active digital beam forming phased array antenna (PAA) is one of the enabling technologies. Graphene is one-atom-thick planar sheet of carbon atoms that has mobility of charge carriers in excess of 200,000 cm2V−1s−1. It is the lowest resistivity substance known at room temperature. The extremely low resistivity makes graphene the next generation conductor that we are going to use as interconnects and antenna elements. Graphene also has supreme mechanical properties extremely suitable for flexible electronics. It is lighter, stronger, harder and more flexible than steel. Furthermore, it is a recyclable and sustainably manufacturable product that is eco-friendly. Another advantage of graphene antennas is that due to the reduced wave propagation speed of graphene, the size of antenna can be reduced to a factor of 10, which is critical for the routing and power dissipation for large number element arrays. Prototype of a fully graphene-based 4-bit 4-element digital beam forming PAA on flexible substrate such as Kapton, including antennas, field effect transistor (FET) switches and phase shifters will be developed. Performance features of the flexible PAA will be characterized including frequency/bandwidth, gain/efficiency, and power consumption. The flexible high-speed electronics will enable active PAA deployment for NASA's lunar mission, including pressurized rovers, pressurized habitats, surface navigation, EVA, and etc.

Primary U.S. Work Locations and Key Partners





Low Cost Flexible Graphene-based Digital Beam Forming Phased-array Antennas Project Image

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Organizations Performing Work	Role	Type	Location
Omega Optics, Inc.	Lead Organization	Industry	Austin, Texas
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
Texas State University	Supporting Organization	Academia	San Marcos, Texas

Primary U.S. Work Locations	
Ohio	Texas

Project Transitions

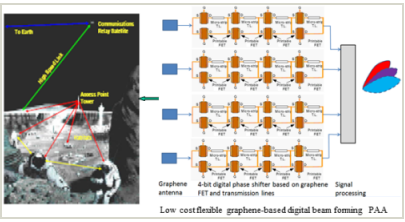
June 2014: Project Start

December 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140748)*

Images



Project Image
Low Cost Flexible Graphene-based Digital Beam Forming Phased-array Antennas Project Image *(https://techport.nasa.gov/image/137269)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Omega Optics, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

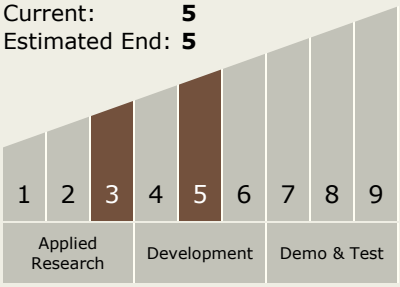
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Harish Subbaraman

Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



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Technology Areas

Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  - TX05.2 Radio Frequency
    - TX05.2.6 Innovative Antennas

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System